College of Liberal Arts and Sciences
Marine Sciences

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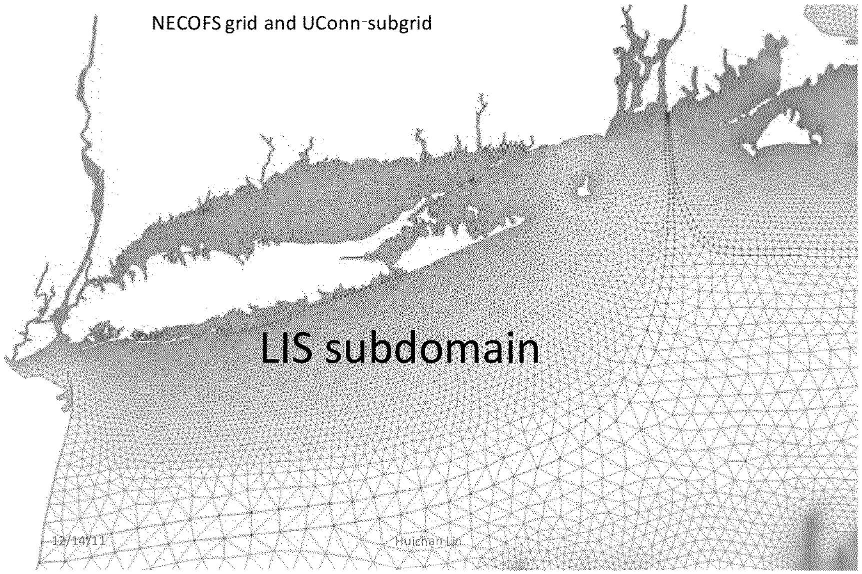
Observation and Model Plans and Status

James O'Donnell
University of Connecticut

Overview

1. Introduction
2. Bottom Stress and circulation are central to the site designation process.
   a) Consideration of all possible sites is only possible if models are used to “interpolate” between the limited location and times data is available using a model.
   b) Development and evaluation of model requires data.
3. Model
4. Summary of the data required to predict the range of circulation and bottom stresses expected throughout the ZSF.
5. Observation Plan

Model - FVCOM



Outer domain simulated by UMass Operationally through NOAA funding

This is a well established code and has been implemented in LIS already.

It is nested inside the UMass Dartmouth Regional Model.

FVCOM will be used to simulate the circulation and wave height and period distributions, and bottom stress.

Challenges are to get hydrography variability correct in the ZSF domain and wave model implemented and assessed.

Integration of Model and Data

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- Use observed winds and river flows to drive model and predict the salinity, temperature, current and waves, and bottom stress.
- Compare to the new and archived observations and evaluate FVCOM performance in LIS.
- Describe the uncertainties.
- Simulate the behavior under extreme events

Analyses

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- Observations and model predictions will be used to describe the distributions of current and stress for site screening.
- Uncertainties will be based on model-data comparisons
- When sites are being considered there results will be used to drive the STFATE and LTFATE models.
- Uncertainties will be propagated by mulitple simulations.

Models STFATE- LTFATE

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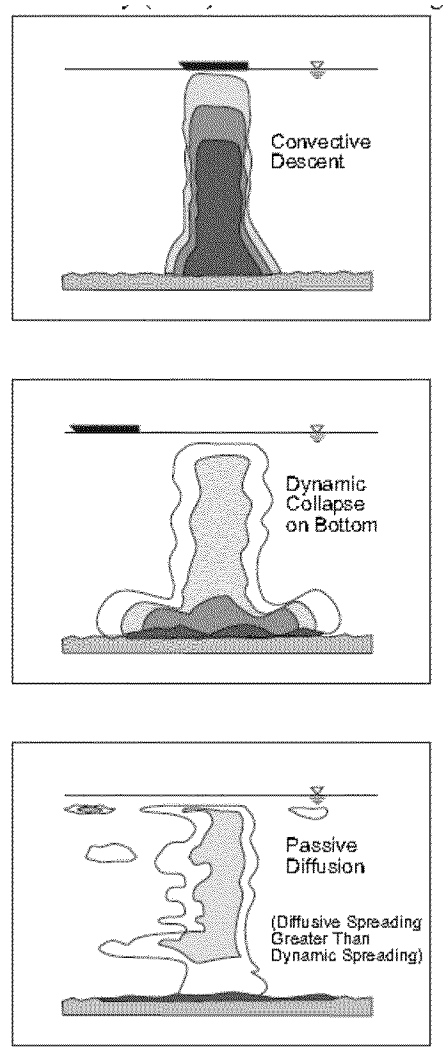
- STFATE – Near field transport during disposal operations
- FVCOM will provide currents, waves and shear for STFATE studies at sites under consideration
- Multiple simulations will define areas of potential impacts



LTFATE

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- LTFATE simulates the long term transport of resuspended materials from disposal mound. This requires regional current patterns, and waves forecasts from FVCOM. We will simulate the effects of historic events at alternative sites

2. Summary of data needs – controlling factors.

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1. Current in the ZSF controlled by tides, density variations and winds.
2. Bottom stress if determined by current and waves.
3. Waves are generated by wind.
4. We want to know the circulation and stress during normal conditions (for each season) and for extreme conditions.
5. We can only observe them all for selected interval and at a few places so we need a model to generalize the observations.

3. What is available ?

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- Three great resources:

1. Woods Hole Group (201). Long Island Sound Dredged Material Management Plan (DMMP) Phase 2 Literature Review Update June 2010, Prepared for U.S. Army Corp of Engineers, Contract No. W912WJ-09-D-0001-TO-0022

2. O'Donnell, J., R. E. Wilson, K. Lwiza, M. Whitney, W. F. Bohlen, D. Codiga, T. Fake, D. Fribance, M. Bowman, and J. Varekamp (2013). The Physical Oceanography of Long Island Sound. In *Long Island Sound: Prospects for the Urban Sea.* Latimer, J.S., Tedesco, M., Swanson, R.L., Yarish, C., Stacey, P., Garza, C. (Eds.), 2013 (Elsievier, In press).

3. Codiga, D. L. and David S. Ullman (2010). Characterizing the Physical Oceanography of Coastal Waters Off Rhode Island, Part 1: Literature Review, Available Observations, and A Representative Model Simulation (http://seagrant.gso.uri.edu/oceansamp/pdf/appendix/02-PhysOcPart1-OSAMP-CodigaUllman2010.pdf.)

- And our Task 2 report

4. Summary of data needs – variables

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1. Sea level at the edge of the shelf to force tides and the interior of the model domain to check it.
2. Wind over the ocean to force the circulation and waves.
3. Solar radiation to force temperature variations.
4. River discharge measurements to force variations in salinity.
5. Salinity and temperature measurements at boundaries to prescribe conditions and in the interior to check predictions.
6. Current measurements to evaluate the model predictions
7. Wave measurements to evaluate the model predictions
8. Bottom stress measurements to evaluate the model prediction

Salinity & temperature, from Buoys.

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S-salinity, **T**-temperature, **DO**-dissolved oxygen (membrane sensor), O-dissolved oxygen (optical sensor), CH-chlorophyll (RFU only)

	CLIS Water			ELIS water		
Year	SFC	MID	BTM	SFC	MID	BTM
2012	S,T,CH,O	---	---		---	---
2011	S,T,CH,O	---	---		---	---
2010	S,T,CH,O	---	---	S,T,DO	---	---
2009	S,T,CH,O	---	---	S,T,DO	---	---
2008	S,T,DO	---	---	S,T,DO	---	---
2007	S,T,DO	---	---	S,T,DO	---	---
2006	S,T,DO	---	---	S,T,DO	---	---
2005	S,T,DO	S,T,DO	S,T,DO	S,T,DO	---	S,T,DO
2004	S,T,DO	S,T,DO	S,T,DO	S,T,DO	---	S,T,DO
2003	S,T,DO	S,T,DO	S,T,DO	S,T,DO	---	S,T,DO
2002	S,T,DO	S,T,DO	S,T,DO	S,T,DO	---	S,T,DO
2001	---	---	---	S,T,DO	---	S,T,DO
2000	---	---	---	S,T,DO	---	S,T,DO
1999	---	---	---	S,T,DO	---	---

Data Gap Summary

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- No Stress
- Waves only at CLIS buoy ZSF
- No North-Sound variation in density in LIS
- No hydrography or current profile measurements in BS-RIS
- Seasonal variations in wind & wave and river discharge are substantial.

5. Proposal for Observations

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- October-March have frequent high winds from NE
- Wind forcing is less in May-Sept
- River Flow is high Mar-May and below average the rest of the year
- Need current, wave and stress measurement in a range of locations in each forcing regime.
  - Windy, low flow (March + Nov-Dec)
  - Windy High Flow (April-May)
  - Calm, below average flow (June-July)

Station	Latitude (degrees north)	Longitude (degrees west)
1	41.2000	72.4000
2	41.1500	72.3700
3	41.2583	72.2422
4	41.1500	72.0000
5	41.1500	71.7500
6	41.2500	71.8000
7	41.2600	72.1000

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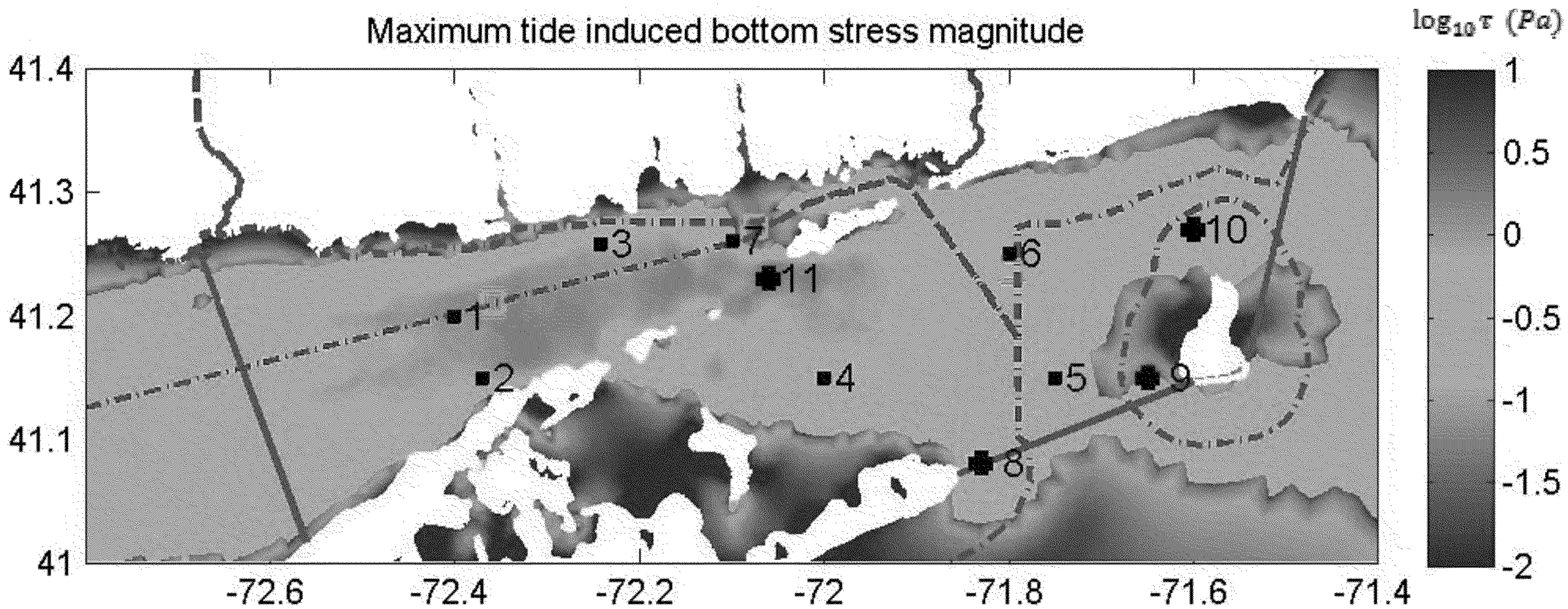

Figure 5. A map of the eastern end of LIS and the Block Island Sound with colors showing preliminary estimates of the distribution of the maximum bottom stress (N/m^2) produced by tidal currents alone. The red lines show the boundaries of the zone of siting feasibility (ZSF). The black squares show the proposed locations of moored current measurements. The open magenta squares indicate the location of existing or historical dredge material disposal sites.

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Bottom Instrumentation

1. Upward looking RDI ADCP to measure profile (1-0.5m resolution) of current and wave statistics
2. Downward looking Nortek ADCP with 5cm resolution bottom to 75cm to measure stress and acoustic backscatter intensity
3. CTD to measure salinity, temperature and bottom pressure
4. Optical backscatter at .2 and .8 m to infer SPM concentrations

Profiling Instrumentation

1. Hull mounted ADCP to survey current patterns
2. CTD to measure salinity, temperature and pressure
3. OBS 3+, optical backscatter to infer SPM concentrations
4. Water sampler for SPM concentration calibrations
5. LISST-100 to measure particle size spectra
6. AC9 Optical absorption spectra for discriminating organic and inorganic material

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- Questions and advice?